

SOL 1066, August 6, 2015

Curiosity leaves Lions outcrop for a drive to Marias Pass after obtaining a drilled sample currently undergoing analyses by the CheMin and SAM instrument teams, teams populated by EISD scientists.

Image: Navcam, NASA JPL

Mars
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The EISD Newsletter



August 2015

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EISD explorers

Welcome to The Newsletter!

Wow - I am amazed at how fast a year goes by. We formed EISD a year ago to focus on the integration of exploration mission architecture, mission integration, future vehicles, advanced projects, Extravehicular Activity (EVA), technology, partnerships, and science. It has been a busy year with many highlights including the 50th Anniversary of EVA and execution of five US spacewalks, a successful test flight of Orion in December with radiation sensors developed by Advanced Exploration Systems inside the crew module, and many significant science discoveries on Mars including perchlorates in the soil as determined by the joint JPL/ARES science team using instruments on Mars Science Lab. Astromaterials Research Manager Dave Draper stepped up to a lead role in organizing the science team and developing the Center's first competitive Science Mission Directorate Discovery program proposal for a mission called Moon Age and Regolith Explorer (MARE).

These are just a few of the many exciting projects and activities underway in EISD and a few more of these will be highlighted in this newsletter which will be published monthly. I hope that you find this publication useful in learning a little more about what is transpiring in Exploration at JSC. We are working on other avenues to communicate more frequently and to allow the entire team to better appreciate the body of work that is ongoing in the Directorate. We have a truly amazing team of dedicated employees and I am proud to be a small part of our team.

Steve



Human in
the loop PLSS testing

MCAT Rises
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Congratulations

awards presented as of August

2015 Rotary Stellar Award - Late Career Category

Eric Christiansen, XI4

NASA Exceptional Service Medal

Carl Allen, XI2

NASA Exceptional Service Medal

Lori Crocker, XX

NASA Exceptional Service Medal

Fred Kuo, XB

Silver Snoopy

Chip Sheperd, XP (below with family)



NASA Equal Employment Opportunity Medal

Eileen Stansbery, XA

Power of One Award – Gold

Michael Chandler, XS

JSC Outstanding Co-op Award

Cullen Balinski, XB

NASA Group Achievement Award – ORDEM Team

XI4- Phillip Anz-Meador, Brent Buckalew, Joe Caruana, Heather Cowardin, James Frith, Joe Hamilton, Matt Horstman, David Jarkey, Quanette Juarez, Robert Kelley, Paula Krisko, Sue Lederer, J.-C. Liou, Mark Matney, Richard McSheehy, John Opiela, Debra Shoots, Gene Stansbery, Andrew Vavrin, Yu-Lin Xu

NASA Group Achievement Award – EFT-1 Imagery Science and Integration Team

XI4- Kevin Beaulieu, David Bretz, Eleanor Cizek, Chris Cloudt, James Heydorn, Danny Labasse, Marco Lozano, Randy Moore, Eric Nielsen, Ed Oshel, Michael Rollins, Robert Scharf, Dan Smith, Amanda Taylor

Morocco's Knight Decoration for National Merit

Asmaa Boujibar, XI3

SEB Award

Dwight Auzenne -XP, Rebecca Bresnik-AL, Christina Hibbs-BG, Herbert Rocha-BB, Victoria Stowe-XB, Robert Tepfer-AL

The MCTB in launch config on left (blue cubes) and in deployed on-orbit config displayed by EC7's Shelly Baccus, left, Project Manager and Melissa Borrego, Project Engineer



AES Logistics Reduction

The Logistics Reduction project, a component of EISD's Advanced Development Projects (ADP) a pathfinder for the new ISS Class 1-E hardware process, delivered four acoustic Multi-Purpose Cargo Transfer Bags (MCTB) for launch on Orb-4 in December. For launch the MCTB serves as a storage container for cargo, just like a normal CTB. Once on-orbit, the Acoustic MCTBs are unfolded and deployed to serve as acoustic barriers in Node 3, with this first deployment targeting the reduction of noise imparted by the treadmill. The installation of two MCTBs on the wall of the Waste and Hygiene Compartment and two on an Avionics 2 Rack are predicted to reduce the treadmill noise by ~50%. The MCTBs also incorporate the new ISS combo radio frequency ID (RFID) inventory tag.

DID YOU KNOW?

The Logistics Reduction (LR) project utilizes a cradle-to-grave approach to reduce total mission logistical mass through direct and indirect means. Various technologies under development in the project will reduce the launch mass of consumables and their packaging, enable reuse and repurposing of items and make logistics tracking more efficient. Repurposing also reduces the trash burden onboard spacecraft and indirectly reduces launch mass by replacing some items on the manifest.

Dr. Asmaa Boujibar, a NASA Postdoctoral Fellow in ARES, is decorated by His Majesty King Mohamed VI on July 30, Morocco's National Throne Day. Asmaa was bestowed The Knight Decoration for National Merit as "one of the three Moroccan women living abroad who have distinguished themselves in their fields"



Check Out TechPort!

<http://techport.nasa.gov>

The Technology Portfolio System, or TechPort is NASA's first comprehensive resource for locating information about NASA-funded technology development activities. The system enables the public to explore NASA's technology portfolio and learn about tech programs and projects, as NASA works to mature numerous technologies for aeronautics, space exploration, and scientific discovery missions.

As of February 2015, TechPort contained information on more than 1,200 active technology development Programs and Projects, and thousands of historical records. The addition of projects associated with the International Space Station Program, the Commercial Crew Cargo Program, and the Science Mission Directorate, is underway.

Even though not fully populated, there are thousands of Projects to explore. Records span the 2001 Small Business Innovative Research (SBIR) Projects through to current technology development.

As a repository for technology development, TechPort does not include basic research but does include many scientific instruments that support research. Additionally, TechPort is a dynamic system which means that programs and projects will continue to be added.

You may have something to add to TechPort too! To learn more about access for submitting your work contact Ann Whitener, the JSC TechPort Liaison, at ann.t.whitener@nasa.gov.



BEAM

The Bigelow Expandable Activity Module (BEAM), pictured at Bigelow Aerospace in Las Vegas, arrived at KSC's Space Station Processing Facility (SSPF) on July 23. BEAM will remain in storage until the SpaceX-8 launch date is set.



DTN 101

DTN is a term popping up in EISD activity reports. It stands for Delay/Disruption Tolerant Networking. DTN is a standard suite of communication protocols that enable internetworking in environments with delays and disruptions, such as the space environment. Soon it will be common terminology for space faring teams.

DTN service will be operational on ISS in 2016 for payload communications and the technology will enable the future build-out of the Solar System Internet to support space communications. DTN is an international effort, with NASA's participation packaged as an Advanced Exploration Systems (AES) project and managed by XS/Exploration Development Integration Office. Contact Project Manager Brenda Lyons for more information, brenda.eliason.lyons@nasa.gov

DID YOU KNOW?

The AES DTN team performed on-orbit checkouts in preparation for the SUPVIS-E demonstration. SUPVIS-E aims at simulating selected future Human exploration scenarios including immersive remote control of a robot by an astronaut in orbit around a target object (such as Mars or the Moon). A crew member will control the ESA test rover located at ESOC (Germany) in near real time over a DTN link.

MCAT Telescope on Ascension Island: Installation Complete

June 2015 marks the completion of the installation of the Meter Class Autonomous Telescope (MCAT) facility on Ascension Island. The telescope is a joint project between NASA's Orbital Debris Project Office (ODPO), housed within EISD, and the U.S. Air Force Research Laboratory (AFRL). MCAT, a double-horseshoe mount telescope and one of only two in the world, allows tracking of Geosynchronous Orbit (GEO) debris and fast-moving low Earth orbit (LEO) debris to support ODPO's agency role in characterizing the debris environment.



The MCAT logo was designed with the assistance of Ascension Island students at Two Boats School. The broken satellite

represents space debris and the Southern Cross reminds of MCAT's southern hemisphere location. The hatchling, representing hundreds of turtles that migrate from Brazil to Ascension each year, symbolizes the shared love of dark skies between astronomers and turtles.

DID YOU KNOW?

NASA's Orbital Debris Program Office (ODPO), housed in EISD, provides a representative to the US delegation to the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS). Dr. J.-C. Liou, a member of ODPO and NASA's Chief Scientist for Orbital Debris fills the role [pictured at the Vienna meetings this year].



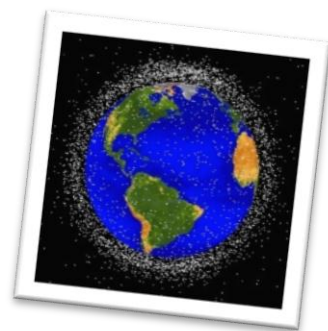
For more information

<http://www.unoosa.org/oosa/en/ourwork/copuos/comm-subcomms.html>

Orbital Debris and its Impact on Space Exploration Activities

by Marlee Pereda-Ramos

Since the early days of the space program, satellites have been launched into low Earth orbit (LEO) and geosynchronous Earth orbit (GEO) for the sake of GPS, the Internet, satellite TV and radio, and other communication systems on which we heavily rely and use on a daily basis. Many of us have never really considered how space conditions are impacted once the satellites become obsolete.



Functional and non-functional satellites, spent rocket bodies, and other fragments of spacecraft explode or collide with each other, releasing numerous pieces. In LEO there are currently more than 20,000 pieces of debris larger than a softball, 500,000 pieces roughly the size of a marble, and 100 million pieces of debris so small they are impossible to track.

All these pieces, especially the ones we cannot track, pose very real dangers for spacecraft because of the high speeds they attain. In a recent interview with Dr. Jer-Chyi "J.-C." Liou, NASA's Chief Scientist for Orbital Debris (OD), he said: "The average impact speed of orbital debris in LEO is about 10 kps. That's more than 10 times faster than a bullet."

The ISS occasionally performs maneuvers to avoid collisions with large trackable fragments. In the days of the Space Shuttle, two window panels from each mission, on average, were replaced due to impacts from orbital debris found to be smaller than a fingernail. During EVAs, on-trackable fragments pose real danger by piercing through a suit.

In 1996, a French satellite was hit and damaged by debris from a French rocket that had exploded a decade earlier. In 2007, China's anti-satellite test, which used a missile to intentionally destroy an old weather satellite, added more than 3,000 pieces of trackable debris. And on Feb. 10, 2009, a defunct Russian satellite collided with and destroyed a functioning U.S. Iridium commercial satellite. This collision added more than 2,000 pieces of trackable debris to the inventory of "space junk," as some call it.

Yet at times it is faulty hardware that contributes to the problem of orbital debris as seen on Feb. 3, 2015 when a Defense Meteorological Satellite Program (DMSP) spacecraft experienced an explosion of one of its Ni-Cd batteries and generated more than 100 trackable debris.

Since 2002 there has been a push for more international cooperation among space agencies to follow the mitigation guidelines set forth by the Inter-Agency Space Debris Coordination Committee (IADC), which addresses orbital debris issues and encourages the space community to utilize procedures that minimize the creation of new orbital debris.

"In terms of big break-up events, we expect to see one such event every five to ten years, and that trend will continue because we are in a linear increase regime. So we will see that frequency for about the next 30 or 40 years. Beyond that, it depends on how well we can follow the mitigation guidelines," Liou explains. Mitigation is not a cure, and Liou agrees a more long-term solution will be needed. "The sky is not falling yet," says Liou, "but [a solution] is certainly something we need to consider."



First Human Landing Site Workshop

The ISRU and Civil Engineering Working Group (co-chaired by EMPO) provided input to the Human Landing Site Study steering group for the First Landing Site/Exploration Zone Workshop for Human Missions to the Surface of Mars. The workshop will be held October 27 to 30, 2015, at the Lunar Planetary Institute (LPI) in Houston, TX to identify and discuss candidate locations where humans could land, live and work on the Martian surface.

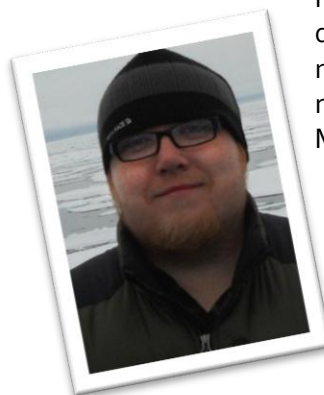
<http://www.hou.usra.edu/meetings/explorationzone2015/>

And Then There Were Eight: Mars 2020 Landing Site Options Are Narrowed

Mars 2020 meetings in Acadia, California during the week of August 3 included review of potential landing sites for the rover, resulting in a refinement of the list from 21 candidate sites to 8. ARES scientists and astromaterials curators provided a vote in the refinement process, with special consideration to the caching of Mars samples for return to Earth (JSC) by a subsequent mission. Attendees Francis McCubbin, Marc Fries, Cindy Evans, and Mary Sue Bell can be contacted for more information, including Marc's presentation during the event. One of many related articles can be found at: <http://news.sciencemag.org/space/2015/08/mars-scientists-tap-ancient-river-deltas-and-hot-springs-promising-targets-2020-rover>

NASA Challenge: Pioneering Mars - Achieving Earth Independence

The InnoCentive Space Pioneering Challenge, which closed on July 6, had almost 60,000 views from the public resulting in 772 proposal submissions. The challenge focused on the elements of "pioneering space" required to establish a continuous human presence on Mars. The Solvers were asked to describe Mars surface systems, capabilities, and operations that could minimize reliance on support from Earth. The top 5 to 10 proposals will be selected by September 8 with awards ranging from \$5,000 to \$15,000. Visit <https://www.nasa.gov/offices/COEC/>



Resource Prospector

The prototype Resource Prospector (RP) rover, a multi-center project with AMES, KSC and JSC, moved for the first time during mid-August testing in the JSC rock yard. The rover was outfitted with a sampling drill and the RESOLVE volatiles characterization payload for the tests, which simulated prospecting for volatiles on the Moon. NASA EDGE will film some of the test and the rover will be featured during media day in late September that JSC employees are invited to attend. Follow Resource Prospector and other AES projects on [Twitter](#) and [Facebook](#).



KSC Center Director, Bob Cabana and JSC Center Director, Ellen Ochoa at Resource Prospector field test

NASA's Mars Sample Curator

EISD welcomes new ARES employee, Dr. Francis McCubbin, filling the roles of Astromaterials Curator and Mars Sample Curator. His research is primarily focused on determining the abundances and roles of volatiles (H₂O, F, Cl, S, C) in magmatic systems on Earth, Moon, Mars, and asteroids.

Francis McCubbin during the 2011 Arctic Mars Analogue Svalbard Expedition (AMASE), where he participated in the testing of instrumentation for future Mars rover missions

The Season of CDRs

It may seem that a flight with an Orion spacecraft using the Space Launch Systems (SLS) vehicle is years away, however a pivotal phase of mission development is upon us in the form of a “season of CDRs, or Critical Design Reviews”. Each program associated with Exploration Missions (EMs) - the Multipurpose Crew Vehicle Program (MPCV) for the Orion spacecraft, the SLS Program for launch vehicle, and the Ground Systems Design Operations (GSDO) Program for the launch facility - conduct their own design review process. SLS recently completed their Critical Design Review (CDR), MPCV just kicked theirs off, and GSDO will kick off in October.

With each program on their own course, who’s integrating? The answer is EISD’s Exploration Development Integration (EDI) Office. EISD is reviewing all documents, identifying issues, and facilitating cross-program collaboration to eliminate disconnects. Additionally, EDI is supporting the MPCV MCC kick-off that is underway, reviewing approximately 25 products to ensure accountability for capabilities required for successful mission management.

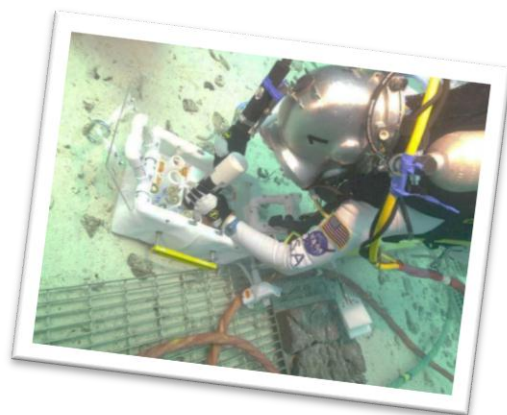
Other EISD teams are also involved in CDRs. The Performance Management and Integration Office (PMI) is working with MPCV in assessing their ability to meet key decision points. The EVA Management Office is tied in for suit interface requirements. Astromaterials, Research and Exploration Science (ARES) is providing expertise in spacecraft shielding, risk assessment for micro meteoroid and orbital debris (MMOD), optical properties of spacecraft windows, and imagery planning.

NEEMO 20

Three divisions of EISD (XX, XI, and XM) supported the two-week NEEMO (NASA Extreme Environment Mission Operations) mission. The analog mission at Aquarius Reef Base in Florida used a four-person aquanaut crew to evaluate exploration techniques and strategies. NEEMO 20 debuted a first-of-its-kind integrated geology sampling kit for microgravity exploration that was developed through collaboration between the EVA Management Office, Astromaterials Research and Exploration Science Division, and JSC tool developers. Sample collection techniques were evaluated (see photo at right) for preserving sample integrity and minimizing contamination. Crew training and real-time support during EVA by EISD personnel provided realistic planetary geology scenarios. For more info go to [NEEMO on nasa.gov](http://NEEMO.on.nasa.gov).

DID YOU KNOW?

- ✓ The Season of CDRs for EM-1 culminates with Build-To-Sync or BTS. BTS, a formal review currently planned for January 2016, will provide evidence that completed integrated system designs, interfaces and methods of integrated hazard control are synchronized with integrated design analysis models prior to delivery of hardware and software end items for EM-1. EDI will play a significant role in the development of most of the products required to meet the entrance criteria for BTS, in addition to providing facilitation services.
- ✓ Three EISD payloads headed for ISS, are undergoing a season of fast-paced review as pathfinders for the new ISS Class 1-E flight hardware process – The Space Debris Sensor (SDS), a project of the Orbital Debris Project Office, STRATA, an ARES regolith study, and DNA Sequencer, an ARES/HHP project.



Z-2 Suit Prototype

Advanced Exploration Systems (AES) will complete prototype manufacturing and acceptance testing of the Z-2 Suit this fall, marking development of the agency's first new high-fidelity planetary suit prototype since Apollo. Earlier this year, the team completed the Advanced Suit Chamber B Z-2 Suit Test Setup Delta CDR. Chamber testing is planned to start January 2016 and will include several first-generation components.



Z-2
Suit

DID YOU KNOW?

The PXS and Z-2 suits are two suits preparing for extensive testing in 2016. While each of the suits have commonalities, they have different applications. The PXS suit, a project of EISD's EVA Management Office, is designed for micro-gravity EVA tasks. The Z-2 suit, an Advanced Exploration Systems (AES) project, is designed for planetary surface "walking" EVA. PLSS development is multistage, with versions 2.0, 2.5, and 3.0 and with the ability to be integrated into either prototype suit.

**Have a newsletter
idea or suggestion?**

Email

wendy.l.watkins@nasa.gov

EVA Excitement: Reviews and Evaluations Keeping Everyone Busy

It is an exciting and busy time in EVA – our colleagues in JSC-EA hosted their Portable Life Support System (PLSS) 2.5 Design Status Review (DSR) in early August, and the Constellation Space Suit System (CSSS) contract is hosting their Design Status Review (DSR) for the Prototype Exploration Suit (PXS) at the end of the month, pictured at right.

Additionally, the Asteroid Redirect Mission (ARM) is hosting a Concept of Operations review at JSC for the crewed-phase of the mission. Team members from NASA-Glenn, Goddard and JPL are expected to travel to JSC in late August to discuss crew operations, including "Crew Safe" evaluation of the vehicle design for EVA tasks.

Finally, ISS US EVA systems recently conducted the installation of a replacement Fan-Pump-Separator (FPS) on EMU 3011. Current discussions are targeting October for the next planned US EVA and may be a back-to-back pair to capitalize on ops efficiency. Additionally, our EVA colleagues in Russia just successfully completed their own EVA activities on the RSOS of ISS and were supported by our joint EVA team in MCC at JSC.



PXS
Suit

SpaceX Mishap Impact on ISS EVA

The June 28 launch failure resulting in the loss SpaceX Commercial Resupply Services 7 (CRS-7) included the loss of approximately \$25 million in EVA hardware destined for ISS. The biggest impact to orchestrating ISS EVA support was the loss of a PLSS, reducing the inventory from twelve to eleven units. The current ISS suit and its PLSS are Shuttle hardware, designed in the 70s.

A PLSS has not been produced since the mid-90s and to build one today would take 18 to 24 months if the parts were available, a length of time driven by exacting specs and extensive testing. However, many of the part manufacturers are out of business and the drawing sets are outdated, thus realistically the manufacture of a PLSS is more on the order of 4 years and an estimated cost of \$20 million.

Currently there are no plans to produce a new PLSS. Greg LeSturgeon of EISD's EVA Management Office estimates that in the near term, ISS EVA support is not greatly impacted. However with 3 of the 4 units on ISS nearing end-of-life, ISS supportability through 2024 will be especially challenging.

Upcoming Events

August 25-27, 2015

NASA Cost Symposium, AMES

<http://www.nasa.gov/offices/ooe/Symposium.html>

September 8, 2015

NASA Challenge: Space Pioneering – Achieving Earth Independence - Award Announcement Date

<https://www.nasa.gov/offices/COECI>

October 27-30, 2015

First Landing Site/Exploration Zone Workshop for Human Missions to the Surface of Mars, Houston, LPI

<http://www.hou.usra.edu/meetings/explorationzone2015/>

November 17-19, 2015

SpaceCom Expo, Houston

<http://www.spacecomexpo.com/>

December 7, 2015

Pumps & Pipes 9, Houston

<http://www.pumpsandpipes.com>

EISD Decoded

XA = EISD = Exploration Integration and Science Directorate

XB = PMI = Performance Management and Integration Office

XI = ARES = Astromaterials Research and Exploration Science Division

XM = EMPO = Exploration Mission Planning Office = EMPO

XP = SPO = Strategic Partnership Office

XS = EDI = Exploration Development and Integration Office

XX = EVA = EVA Management Office

Advanced Development Portfolios = ADP includes AES (Advanced Exploration Systems) and STMD (Space Technology Mission Directorate) portfolios = Randy Lillard/XA & Veronica Saucedo/XM

By day, these scientists from EISD and the Lunar and Planetary Institute toil in their labs. By night, they foster exploration awareness as the "Female Superheroes of Planetary Science". Supporting the NASA booth at Space City Comic Con in July are (L to R): Eileen

Stansbery as Flare, Kristen John as Astro Girl, Georgiana Kramer as The Lunatic Phenomenon, Asmaa Boujibar as Anvil Girl, Emily McBryan as Viking Moon Warrior, and Queenie Chan as Comet Girl

NASA Cost Symposium EISD Paper Submittals

Quantitative Risk Assessment:

An overview of risk analysis concepts at NASA with an International Space Station Program (ISSP) Viewpoint
Kendrick Glenn, XB

This two-part paper provides a unique perspective on life-cycle affordability based on experience with NASA's International Space Station (ISS) Program. The paper emphasizes the importance of affordability as key to risk-informed decision processes, and in turn to sustainability. The first part defines quantitative risk analyses as applied in the ISS Program, and considers the interests of non-profit US-international partnerships and profit-oriented commercial partnerships in the calculation and mitigation of cost and schedule risks over the life-cycle. The second part provides a behind-the-scenes look at a Monte Carlo simulation based on an ISS case scenario.

Portfolio Optimization

Bringing intelligence and insight to the decision making process

Fred Y. Kuo, XB

Technology is continually changing our society and, more than ever, is also providing impetus in advancing the sophistication and creativeness of the project management professionals. In the field of cost and schedule analysis we have seen a proliferation of analysis tools and methods in advancing the understanding and quantification of the impacts of risks. Most of these tools can serve as a powerful analytical platform to bring intelligence and insight to the decision making process. Mathematical programming is a technique that has been widely applied to many management science problems such as logistics, queuing and resource planning. In this paper, the author introduces the concept of mathematical programming and portfolio optimization, and its potential application in the cost and schedule risk analysis.

